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Management of complex urethral stricture disease: Algorithm and experience from a single institute

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ABSTRACT

Objective: There are currently no practical guidelines regarding recurrent or complex urethral strictures in Taiwan. Furthermore a specific urological reconstruction center focusing on urethroplasties in this area is currently unavailable. In this study we aim to share the experience of our institute according to an algorithm for this disease entity.

Materials and methods: From December 2007 to October 2013, adult males with complex urethral strictures were enrolled. Six different surgical techniques were used for treatment. Clinical features and outcomes were analyzed through a retrospective chart review.

Results: The mean age was 39 years, with a mean follow-up period of 42 months (range, 5–76 months). An average of three sessions of previous treatments was noted. The overall primary success, requiring no further intervention, was 46%. Permanent failure occurred in one patient (2.6%). The primary success for urethroplasty in distal, penile, bulbar, posterior urethra, and in stricture with hypospadias was 100%, 40%, 83%, 29%, and 60%, respectively. From the perspective of procedure type, anterior anastomotic urethroplasty (80%) and skin-based flaps (75%) resulted in the highest success rate. Following anterior or posterior buccal mucosal graft-augmented urethroplasties, 40% of patients received additional short-term dilatations or urethrotomies.

Conclusion: Complex urethral strictures can be managed by a variety of surgical techniques according to specific stricture locations. However, a careful postoperative follow-up for recurrences is mandatory, since ~40% of patients undergoing buccal mucosal graft-augmented urethroplasties were expected to have additional procedures after the index urethroplasty.

1. Introduction

Male urethral stricture disease is an old and difficult problem for urologists. Before the era of endoscopic surgery, dilation and open surgery that involved the resection of the strictured segment were the most common treatments. Nowadays, endoscopic direct-visual internal urethrotomy (DVIU) and/or dilations are most commonly used to treat urethral strictures by practicing urologists.[1] DVIU has become the most widely used procedure in Taiwan, largely because urologists are skilled in endoscopic procedures and newly introduced lasers have become available.[2] Unfortunately, either DVIUs or dilations are associated with high rates of recurrence in severe urethral strictures, more specifically, when the strictured segment is > 1 cm in length. In certain situations, DVIUs using either a cold-knife or a laser could not replace the role of open surgery. This has been observed in cases of posterior urethral distraction injuries or in cases of repeated anterior urethral strictures.[3]

Previous studies have shown that the use of multiple DVIUs/dilations to treat urethral stricture disease is associated with an unacceptably high rate of failure. A review article by Santucci et al demonstrated a third DVIU results in 100% failure for the procedure. Therefore, repeated DVIUs or dilations are neither curative, nor cost-effective.[4,5]

There is currently no specific reconstruction center that annually performs > 70 open urethroplasties in Taiwan.[6] Therefore it is important to establish a practical approach to manage difficult or recurrent urethral strictures in the local area. Augmented

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urethroplasty, which uses free grafts from the buccal area, has become prevalent in the past decade. Buccal mucosa grafts (BMGs), initially used in hypospadias repair are nowadays more commonly applied in the field of adult urethroplasty to repair urethral stricture disease. In the report by Barbagli et al,[7] the use of BMG urethroplasty for nontraumatic bulbar urethral strictures is shown to have a success rate of 85%. Stricture recurrence after an urethroplasty represented a surgical challenge. There have been limited reports focusing on redone urethroplasties.[8] In the current study we share our experience and update the knowledge in the management of complex/recurrent urethral strictures. Furthermore, we propose a convenient algorithm for this disease entity.

2. Materials and methods

A retrospective study of patients with complex urethral stricture diseases was performed. The study was approved by the Institutional Review Board of Tri-Service General Hospital. All enrolled patients underwent urethroplasties between December 2007 and October 2013. A complex urethral stricture was defined as either any posterior urethral distraction injury, or any anterior urethral stricture with previously failed surgical interventions. Patients younger than 18 years or with a history of previous intervention using only dilation were excluded. The length and location of the stricture were evaluated by retrograde urethrography and an endoscopic evaluation. Preoperative physical examinations included a careful palpation of the *corpus spongiosum*, to determine the presence of spongiofibrosis. Stricture locations were categorized as distal, penile, bulbar, posterior, and stricture with hypospadias. Distal urethral stricture was defined as stricture location within 1 cm of the urethral meatus, not reaching the penile shaft region. We have proposed a treatment algorithm (shown in Fig. 1) through the review of literature and then modified it by our own experience. Postoperatively, the patients were followed-up in our clinics monthly for the first 6 months. The follow-up studies consisted of an uroflowmetry plus postvoiding residual measurement, and, when symptomatic, an additional retrograde urethrography. The diagnosis of recurrence was made upon cystoscopic confirmation.

The primary outcome of interest was the success rate of surgical interventions, which was further categorized into a primary success (without stricture recurrence and any postoperative intervention), an early success (with minor recurrence within 6 months), a solvable failure (curable recurrence beyond 6 months of surgery) and a permanent failure. Complications and the percentage of patients regaining ability to void through the urethra were also noted.

2.1. Surgical techniques and indications

2.1.1. Anterior and posterior anastomotic urethroplasty

An anterior anastomotic urethroplasty (AU) was considered when either a penile urethral stricture involving < 1 cm or a bulbar stricture involving < 1.5 cm in length. Posterior AU was indicated in patients with posterior urethral distraction injury as the first attempt of reconstruction. The procedure was performed as described by Mundy et al.[9]

2.1.2. Anterior BMG-augmented urethroplasty

This procedure was considered when a simple AU was not possible in anterior urethral strictures. The BMG was placed using an inlay (Asopa technique) in the penile urethral stricture and was placed using an on-lay (standard technique) in bulbar urethral strictures. We employed the techniques described by Pisapati et al[10] and Barbagli et al.[11]

2.1.3. Posterior BMG-augmented urethroplasty

This technique was reserved for strictures that were extremely difficult to treat with the standard re-anastomosis, particularly when re-anastomosis was expected to cause a significant postoperative chordee. An incision was made in the urethral plate at the most reachable proximal point and a BMG was sown and served as a carpet, to widen the urethral lumen. The techniques were described in our previous study.[12]

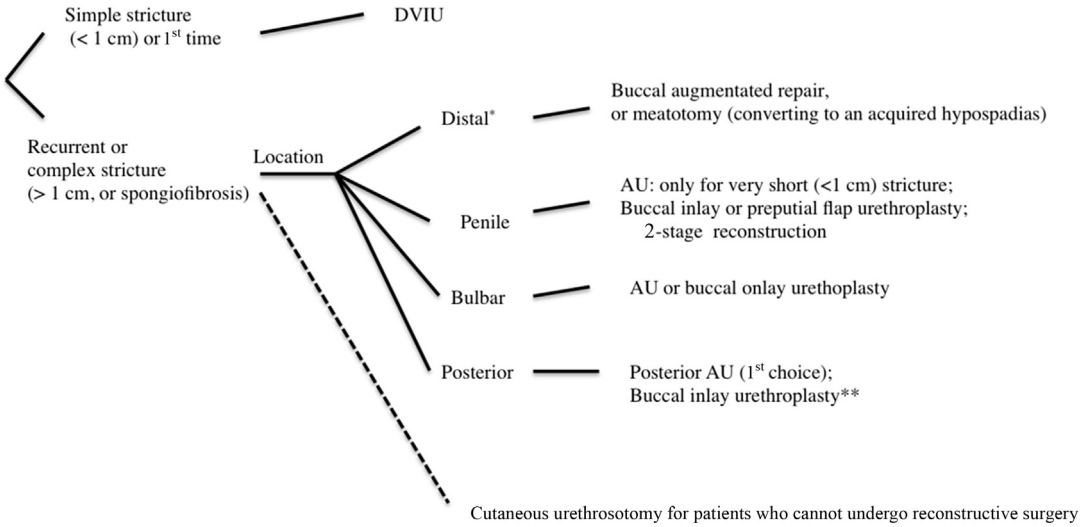

Fig. 1. Proposed algorithm for the management of difficult urethral strictures.

2.1.4. Scrotal or preputial flap

Skin-based flaps were used in a penile urethral stricture when nearby viable tissues were unavailable, especially when the BMG was not possible in some cases. For example, Taiwanese patients with a history of chewing betel nut were frequently found to exhibit a marked fibrotic change inside the mouth, which eliminated the possibility of a BMG.

2.1.5. Perineal urethrostomy

This could be the ultimate salvage procedure and was only used in patients whose urethral strictures cannot be reconstructed. For perineal urethrostomy we used the techniques described by Tang et al.[13]

2.2. Statistical analysis

Patient characteristics and surgical success rates were expressed in descriptive statistics. Numerical variables (e.g., age, stricture length, and previous interventions) were expressed as mean ± standard deviation. The relationship between stricture length and stricture recurrence, and operation time and stricture recurrence were tested by independent *t* test. A Chi-square test was performed to examine whether multiple prior interventions were related to stricture recurrences. Overall cumulative recurrence-free rate was calculated by a Kaplan–Meier survival analysis. All data were processed through SPSS version 19 (IBM SPSS Statistics 19; SPSS Inc., Chicago, IL, USA). A significance level of $p < 0.05$ was set.

3. Results

A total of 39 patients were enrolled. The mean age was 39 years, with a mean follow-up period of 42 months (range, 5–76 months). Demographic data are shown in Table 1. For most patients, the stricture etiology was trauma (51%); others included transurethral surgeries (26%) and posthypospadias surgery (23%). The mean urethral stricture length was 2.7 ± 1.2 cm (range, 1–6 cm). An average of three treatments preceded the index urethroplasty.

Six different techniques were used for treatment in the current study population. Anterior urethroplasty with BMG (28%) and posterior AU (28%) were the most commonly used procedures. Perineal urethrostomy was performed in one patient who refused reconstructive surgery because of an extremely high anesthetic risk. The primary success for urethroplasty in distal, penile, bulbar, posterior urethra, and in stricture with hypospadias was 100%, 40%, 83%, 29%, and 60%, respectively. From the perspective of procedure type, anterior anastomotic urethroplasty (80%) and skin-based flaps (75%) resulted in the highest success rate. In terms of operation time, posterior urethroplasties generally required a longer time than anterior urethroplasties (262 minutes vs. 226 minutes). There were two instances of complications, involving chronic leg pain after prolonged surgery (Table 2).

Thirty of the 39 cases (77%) had either a long-term urethral catheterization or a suprapubic cystostomy before receiving urethroplasty. In total, 37/39 (95%) of cases can urinate through the urethra after surgeries, with 18 (46%) cases of primary success. Anterior AU had the highest primary success rate of 80%. However, posterior BMG-augmented urethroplasty resulted in no primary success and all patients receiving this procedure required additional DVIU/dilations to overcome recurrent strictures. All patients who demonstrated a recurrence beyond 6 months after the urethroplasty would exclusively have a recurrence within 3 months postoperatively. Regarding the timing of recurrences, minor recurrences within 6 months accounted for 35% of the patients, and solvable failures at > 6 months after surgery accounted for 16%. There was one permanent failure (3%), due to the regrowth of cancerous tissue into the anastomotic area in a patient who underwent a previous chemoradiation treatment for rectal cancer. Through univariate analysis, postoperative recurrence of a stricture was significantly related to the length of the stricture, multiple prior surgeries, and longer operation time $p = 0.02$, $p = 0.006$, and $p = 0.01$, respectively. The overall cumulative recurrence-free rate by Kaplan–Meier analysis showed that the recurrence rate became relatively stable beyond the 6th postoperative month (Fig. 2).

4. Discussion

Frequently recurring urethral strictures and posterior urethral distraction injuries are not so rare in Taiwan. There are still debates regarding definition of surgical success rate and standard treatment modalities for complex urethral stricture. Only two randomized trials have been performed, with no definite conclusion.[14] Currently, complex urethral stricture is regarded as an open surgical disease,

Table 1
Patient characteristics stratified by urethral stricture types.

Location	Distal stricture	Penile stricture	Bulbar stricture	Posterior distraction injury	Hypospadias with fistula and stricture	Comment
n (%)	1 (2.6)	10 (25.6)	6 (15.4)	17 (43.6)	5 (12.8)	
Age (y)	43	52 ± 20	43 ± 25	35 ± 18	21 ± 5	
Length (cm)	1	3.6 ± 1.2	1.8 ± 0.4	2.5 ± 0.7	2.8 ± 2	
Previous interventions	1	4 ± 3	1 ± 2	4 ± 3	2 ± 1	
Primary success	100	40	83	29	60	46 (total)
Early success & solvable failures	0	60	17	64	40	51 (total)
Permanent failure	0	0	0	7	0	3 (total)

Data expressed as mean ± standard deviation or %, unless otherwise indicated.

Table 2
The surgical outcomes classified by surgical techniques.

	Anterior AU	Anterior BMG	PosteriorAU	Posterior BMG	Scrotal/preputial flaps	Cutaneouos urethrostomy
n (%)	5 (12.8)	11 (28.2)	11 (28.2)	7 (17.9)	4 (10.3)	1 (2.6)
Age (y)	52 ± 21	41 ± 21	36 ± 20	31 ± 15	27 ± 11	82
Length (cm)	1.5 ± 0.4	1.2 ± 3.6	2.1 ± 0.6	3.0 ± 0.3	1.0 ± 1.5	5
Primary success rate (%)	80	45	45	0	75	100
Operation time (min)	135 ± 39	224 ± 48	226 ± 46	262 ± 41	127 ± 46	100
Complication (*n*)	None	None	None	Leg pain (2)	None	None

Data expressed as mean ± standard deviation unless otherwise indicated.
AU = anastomotic urethroplasy; BMG = buccal mucosal graft.

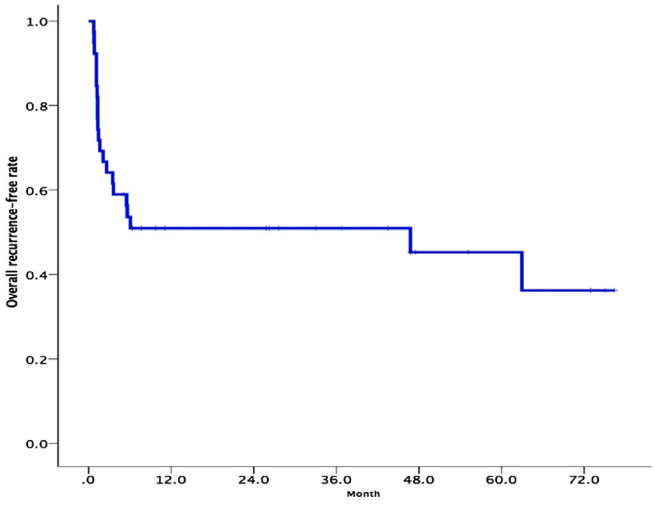

Fig. 2. Overall recurrence-free rate by Kaplan–Meier analysis.

because of the unacceptably high failure rate that is associated with repeated urethrotomies or dilations.[15] By contrast, the primary success of urethroplasty for anterior urethral strictures (i.e., no need for an additional procedure) is as high as 80–90%, according to different reports.[16] In our series, the success rate of bulbar urethroplasties was comparable with reports from reconstruction centers.

It is also known that different stricture locations in the urethra require different strategies for repair.[17,18] Since there is currently no reconstruction center that specifically treats complex urethral stricture disease in Taiwan, in this study we also tried to propose a practical algorithm for reference. Only two patients, including the one undergoing cutaneous urethrostomy, failed to regain the ability to urinate through the urethra by using this algorithm in our hospital. Permanent failure occurred in one case, whose urethra was re-obstructed by cancerous tissue of colorectal carcinoma. We did not have wound complications as reported by other authors.[19] Instead, we experienced two cases of chronic debilitating leg pain, which were self-limited after 6 months. In the future, careful protection of legs during a high lithotomy position and a prolonged surgery should be emphasized, and the patient should be informed of the possibility of such a complication before surgery.

However, the value of this study is limited due to a relatively small number of cases, heterogenicity of strictures, and a wide range of surgical techniques.

The technique of BMG-augmented urethroplasty for bulbar urethral stricture is easily learnt and has a high success rate. Although penile urethra is also a part of the anterior urethra, strictures in this area were associated with a lower primary success rate than that of the bulbar urethra in our series. It was possibly because the penile urethra lacks sufficient vascular support after urethroplasty as a result of spongiofibrosis. A two-stage BMG urethroplasty has been advocated by some authors in this scenario,[20] but the Asopa technique was our first resort owing to its convenience for patients. Minor recurrences generally required endoscopic treatment once or twice and the prolonged wait for definite urethroplasty can be avoided.

We also noted that 100% of patients who received a BMG-augmented posterior urethroplasty experienced minor recurrence within 3 months of urethroplasty. In this population, the primary goal was to eliminate the need for a suprapubic catheter, but not to achieve an excellent uroflow rate in the early postoperative period. During surgeries we found severe scarring and extensive fibrotic changes around the affected urethra, which compromised the vascular bed for BMG and might contribute to the high recurrence rate. This group of patients generally became stable beyond 6 months after surgery and probably do not require further intervention.

5. Conclusion

Complex urethral strictures can be managed by a variety of surgical techniques according to specific stricture locations. However, a careful postoperative follow-up for recurrences is mandatory, since ~40% of patients undergoing buccal mucosal graft-augmented urethroplasties were expected to have additional procedures after the index urethroplasty.

Conflicts of interest

The authors declare that they have no financial or non-financial conflicts of interest related to the subject matter or materials discussed in the manuscript.

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